

Orthopaedic Division

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Memorandum

To: Brian McKinnon
From: Gary Dawkins *GD*
Subject: **Technical Memo** – Anteverted Liner Push-in, Push-out, and Lever-out Testing
cc: Mark Harbaugh, Abraham Salehi

Date:

Purpose

The purpose of these tests was to compare assembly and disassembly forces generated for anteverted liners with previously tested regular Reflection liners.

Materials and Methods

Tinius-Olsen serial #128770
Bionix MTS 85 -937.77
Labview Data Acquisition #0000764
Acetabular Cup 71330056 81108232 56mm (#1)
Anteverted Acetabular Liner Prototype 28mm x 54/56 +4mm HX0004 (10 parts)

The push-in test was used to evaluate the amount of force required to engage the liner into the cup. Ten liners were pushed into the cup using the push-in test method. Static assembly of components was conducted on the Tinius-Olsen between the compression plates. Each liner was assembled using a 28mm femoral head, which was placed inside the liner and assembled at a load rate of 0.1 in./min. The maximum assembly force for each component was recorded on the X-Y plotter. Figure 1 is a photograph of the test setup.

The push-out test was performed to evaluate the amount of force required to disengage the liner from the cup. Five liners were disengaged using the push-out test method. This test was done by placing the assembled components on parallel plates ensuring that there was no impingement. A 0.25 in. diameter ram was placed in the apex hole of the cup and used to disengage the liner from the cup. Maximum disengagement forces were recorded on the X-Y plotter. Figure 2 is a photograph of the push out test setup.

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The lever-out test was utilized to determine the force required to lever out the liner from the cup. Five liners were tested using this method. The testing protocol paralleled Seth Greenwald's protocol for lever-out testing [1]. A 0.22 in. diameter hole was drilled 0.15 in. down below the rim of the liner. It was done carefully to ensure that the hole did not penetrate the outer diameter of the liner. (This was done before the liners were assembled.) Each of the lever out components was secured to the MTS Bionix 85-937.77 machine. A knife edged fulcrum was placed adjacent to the secured component, 2.5 in. from the edge of the hole in the liner. A metal rod with a 0.22 in. diameter end, was served as a lever, and was placed over the fulcrum and into the hole of the liner. A 1.0 in. diameter metal rod, radiused at the tip, loaded the lever at a rate of 0.1 in./min. until liner separation occurred. The distance between the liner and fulcrum is equal to distance from the fulcrum to the point of the applied load. Figure 3 is a photograph of the lever-out test setup.

Results

The average push-in force value was approximately 165 lbf. The average push-out and lever-out forces were approximately 91 and 122 lbf., respectively. These forces are higher than those generated for Reflection liners. The average push-in, push-out, and lever-out forces for Reflection liners were 70, 66, and 105 lbf., respectively [2].

References

1. Greenwald, Seth et al. "Performance Characteristics of Two Piece Acetabular Cups" Orthopaedic Research Laboratory, Mt. Sinai Medical Center. 1991 AAOS
2. McLean, T., Dawkins, G., "Integrity Testing of the Mechanical Locking Mechanism of Cross-Linked Polyethylene Liners Utilizing the Reflection Cup Design" Smith & Nephew, Inc., Orthopedic Research Technical Memo, TM054901



Figure 1 Push-in Test Setup

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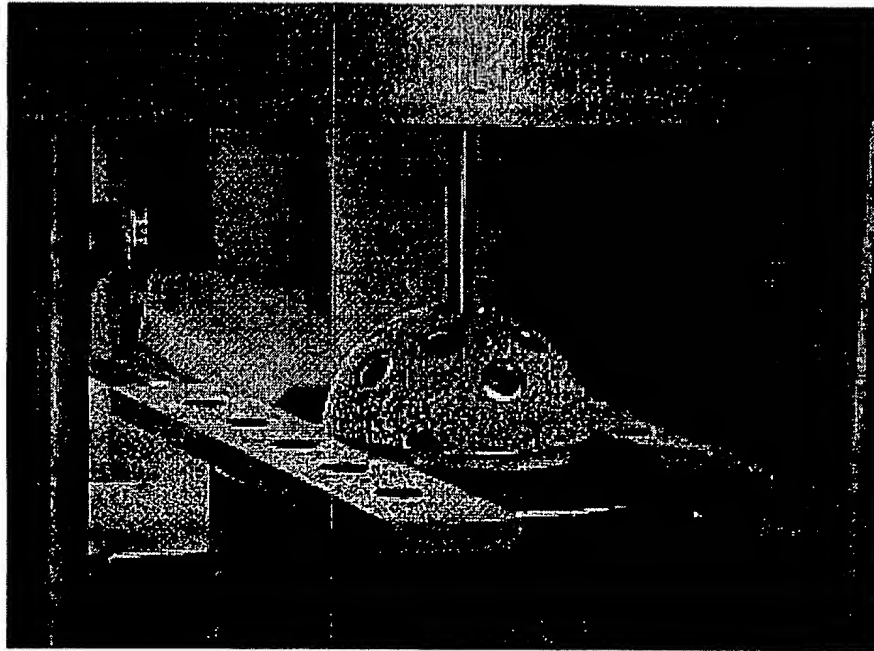


Figure 2 Push-out Test Setup

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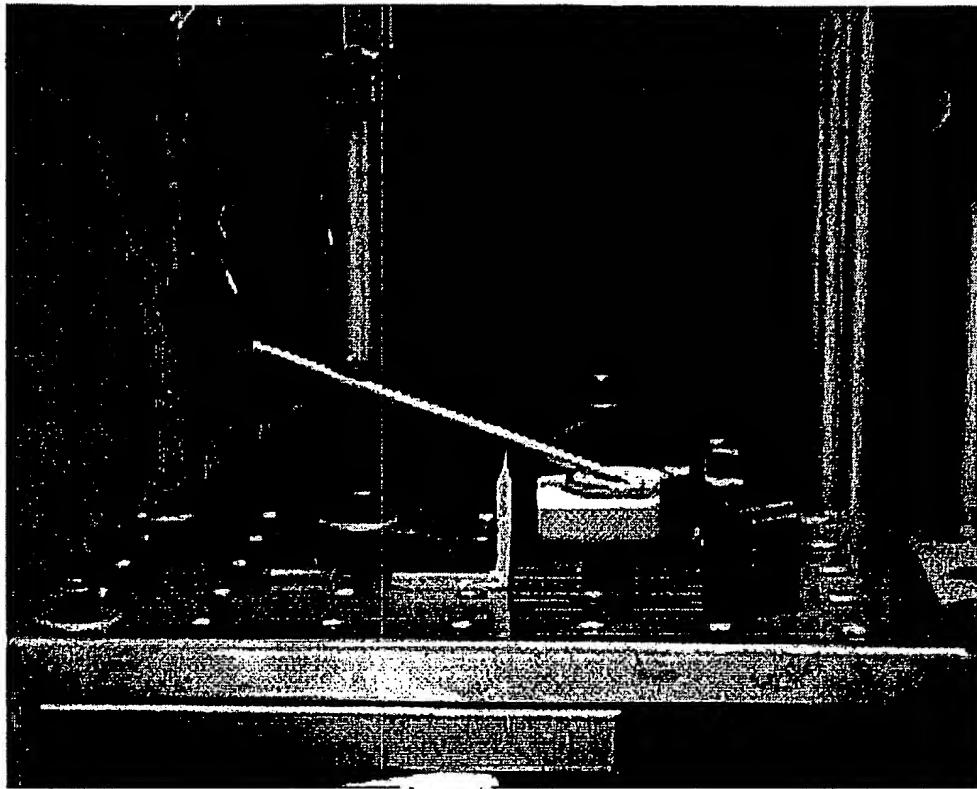


Figure 3 Lever-out Test Setup

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Table 1
Anteverted Liner Testing # 389-175 (1-10)

	Push-in values (lbf.)	Lever-out values (lbf.)
389-175- 1	154.57	116.68
389-175- 2	161.47	104.05
289-175- 3	165.34	140.75
389-175- 4	160.17	123.93
389-175- 5	161.43	124.25
	160.59 average	121.98 average
	Push-in values (lbf.)	Push-out values (lbf.)
389-175- 6	158.12	90.76
389-175- 7	168.98	89.24
389-175- 8	172.17	92.31
389-175- 9	175.30	88.28
389-175- 10	170.63	95.10
	169.04 average	91.14 average

Table 2
Regular Reflection Liner Testing [2]

Average	Push-in	70.64 lbf.
Average	Push-out	66.48 lbf.
Average	Lever-out	104.60 lbf.